

NOVEMBER 2019



2009/10/27

**WIM #39
MN 43, MP 45.2
WINONA, MN**

**MONTHLY
REPORT**



05/05/2010

Your Destination...Our Priority



WIM Site Location

WIM #39 is located on MN 43 near Winona in Winona county.

System Operation

WIM #39 was operational for the entire month of November 2019. Volume was computed using all monthly data.

System Calibration

WIM #39 was most recently calibrated on 2019-06-02. Table 1 summarizes the front axle weights of class 9s by lane ¹. Figure 1 shows the distribution of gross vehicle weights (GVW) in Class 9 vehicles at this site for the last 12 months of operation ². Figure 2 depicts the average front axle weight as a percent difference from the first full month following calibration.

Summary of Volume Statistics

Total Monthly Volume: 260831 | Passenger Vehicles: 243402 | Heavy Commercial Vehicles: 17429

Monthly Average Daily Traffic (MADT): 9710 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 581

See Table 2 for vehicle class breakdown

Passenger Vehicles (PVs) and Heavy Commercial Vehicles (HCVs)

Volume trends. NB vehicles typically reached highest volume levels on Fridays, with lowest volumes reported on Sundays. SB vehicles typically reached highest volume levels on Fridays, with lowest volumes reported on Sundays (see Figure 3 and 4).

Passenger Vehicles (PVs)

Volume trends. On an average 24-hour day (see Figure 5), NB PVs generally reached peak volume levels between 03 PM and 05 PM. Similarly, SB PVs peaked in volume between 07 AM and 04 PM

Heavy Commercial Vehicles (HCVs)

Volume trends. On an average 24-hour day, HCVs traveling NB typically reached peak volume levels between 03 PM and 05 PM, while volume going SB peaked between 07 AM and 04 PM. See Figure 6. Out of all HCVs, the two highest traffic volumes were generated by Class 9's and Class 5's.

Overweight HCVs

Volume trends. Of a total of 17429 HCVs, 4688 of them were overweight ³. These overweight HCVs contributed to 1.8% of total monthly volume, and 27.1% of total monthly

HCV volume. NB overweight vehicles typically reached highest numbers on Tuesdays, with lowest volumes reported on Saturdays. SB overweight vehicles tended to reach highest volumes on Tuesdays, with lowest volumes reported on Sundays. See Figure 3 .

The top two overweight violators by class were the class 9 and class 10 vehicles . Overall, overweight vehicles tended to reach peak volume concentrations during typical business hours, with 57.9% of all overweight vehicles traveling NB this month (see Figure 7 & 8). Figure 9 shows the number of vehicles exceeding 88,000 pounds that crossed the WIM over the last 12 months. The highest number of 88,000+ vehicles within the last 12 months occurred in November.

WIMs are currently used as a screening tool for weight enforcement, and it is estimated that the WIM scales can measure gross vehicle weights (GVW) within 90-95% of static weight scale measurements. Due to the possibility of measurement error, vehicles exceeding 10% of their legal weight limits (or 1.1 times their legal weight limits) are considered overweight in this report ⁴.

Using normal load limits ,1071 NB vehicles exceeded 88,000 pounds (802 vehicles were Class 9's; 118 vehicles were Class 10's). Of vehicles traveling SB,

632 NB vehicles exceeded 88,000 pounds (607 vehicles were Class 9's; 15 vehicles were Class 10's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from November 2019.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in November 2019. Data suggests that there were greater numbers of empty Class 9's than fully_loaded Class 9's traveling NB, while there were more empty Class 9's than fully_loaded traveling SB. Data also suggests that there were more fully_loaded Class 10's than empty traveling in the NB direction. In the SB direction, there were more fully_loaded class 10 vehicles.

Freight Totals. A total of 177814 tons of freight was recorded to have crossed the WIM. More freight was shipped NB (53.5%) than SB (46.5%). See Table 4 and Figure 11 for more freight information.

####Infrastructure Considerations Bridge. Bridge No. 5930 is approximately 0.1 miles north of WIM #39, and Bridge No. 5900 is 0.3 miles south of WIM #39. WIM #39 recorded a total of 260831 vehicles with a combined GVW of 1969784 kips (1 kip = 1,000 pounds = 0.5 tons) in November 2019. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 20243 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 55.5% of all ESALs were recorded NB while 44.5% was observed SB. In particular, 72% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 28% of total GVW observed this month). See Table 6 and Figures 14-15 for more information on ESALs (Table 6 also provides flexible ESAL factors for each vehicle class using a terminal serviceability of 2.5 and a structural number of 5).

#####WIM monthly reports can be found at:

<http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html> MnDOT's vehicle

classification scheme and vehicle class groupings for traffic forecasting can be found at:
<http://www.dot.state.mn.us/traffic/data/data-products.html#weight>

- ¹ Front axle weights of Class 9s are monitored on a monthly basis to assure performance between calibrations. The current goal of the WIM scale calibration is to have each individual axle weight stay within a range of ±9% of baseline calibration values
- ² Previous WIM research indicates that unloaded Class 9s typically weigh 28-32 kips, while loaded Class 9s generally fall in the 70-80 kip range. More recent data from several WIM sites suggests that the unloaded Class 9 range may have moved a little higher over time (due to increased presence of sleeper cabs, etc.), although these ranges are also thought to be site-specific.
- ³ An HCV is considered overweight during normal load limits in this report if they satisfy any of the following 1) exceed a gross vehicle weight (GVW) of 80,000 pounds, 2) exceed any of the legal weight maximums on any axle configurations (legal maximums are: single axle = 20,000 pounds; tandem axles spaced 8' or less = 34,000 pounds; tridem axles spaced 9' or less = 43,000 pounds; quad axles spaced 13' or less = 51,000 pounds). Monthly reports use this standard regardless of the time of year however, the Winter Load Increase (WLI) allows a 10% across the board increase in axle and gross vehicle weights without a permit on US, state routes, and county roads. An HCV is considered overweight during Winter Load Increase(WLI) if they satisfy any of the following 1) exceed a gross vehicle weight (GVW) of 88,000 pounds, 2) exceed any of the legal weight maximums on any axle configurations (legal maximums are: single axle = 22,000 pounds; tandem axles spaced 8' or less = 37,400 pounds; tridem axles spaced 9' or less = 47,300 pounds; quad axles spaced 13' or less = 56,100 pounds). An overweight HCV is only included once in the overweight volume calculations regardless of how many of the aforementioned conditions are violated. For information on MN weight limit dates and statutes:
http://www.mrr.dot.state.mn.us/research/seasonal_load_limits/sllindex.asp
- ⁴ For example, Class 9s and 10s can legally have gross vehicle weights up to 80,000 lbs (with the exception of permitted loads) during normal load limits. To account for measurement error on the WIM scales, those exceeding 10% of the legal GVW maximum (or 1.1 times the legal GVW) should be screened (e.g., 80,000 lbs + 8,000 lbs = 88,000 lbs). Similarly during WLI vehicles weighing 96,800 lbs should be screened.

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Figure 1 - Monthly Class 9 GVW Histogram

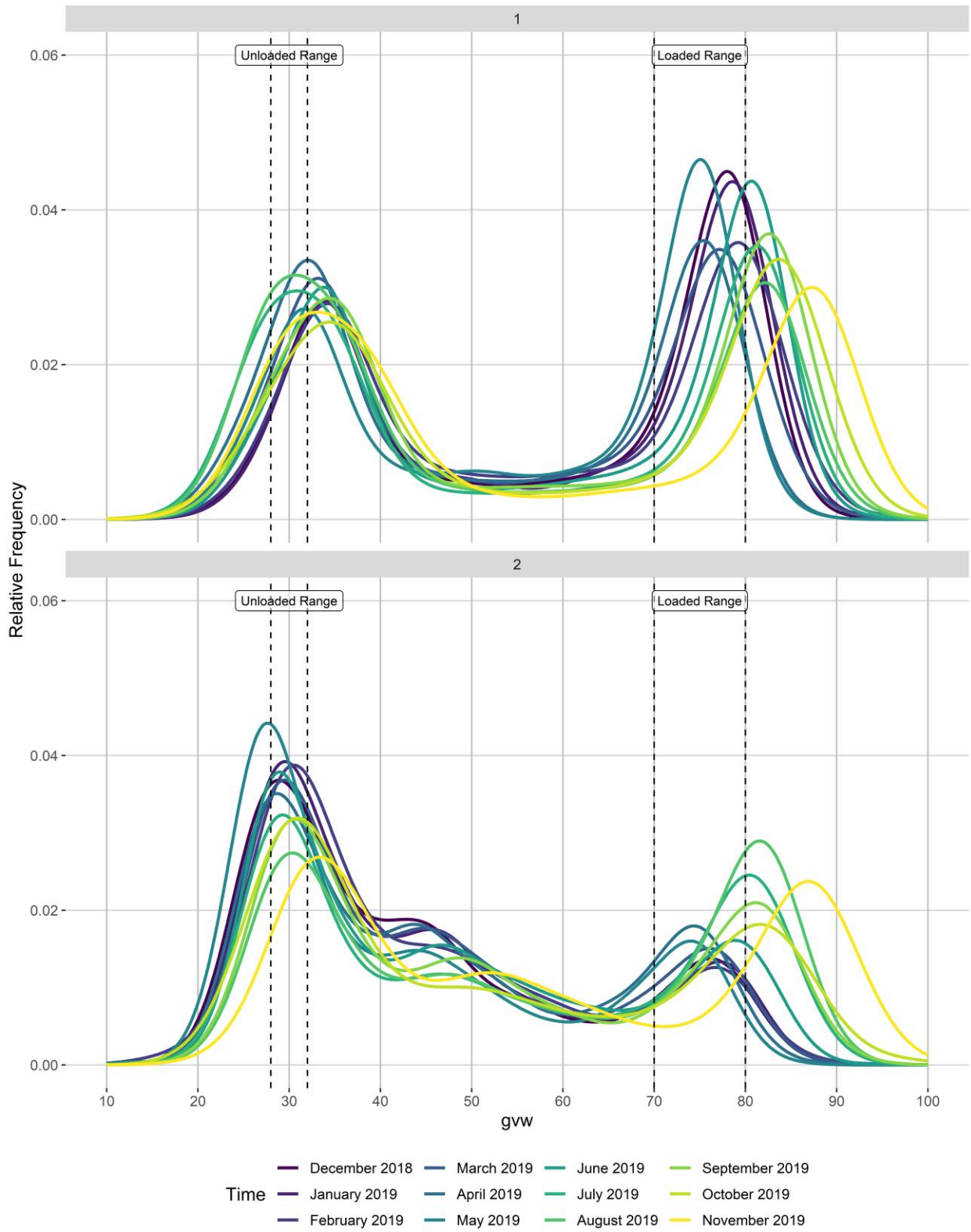
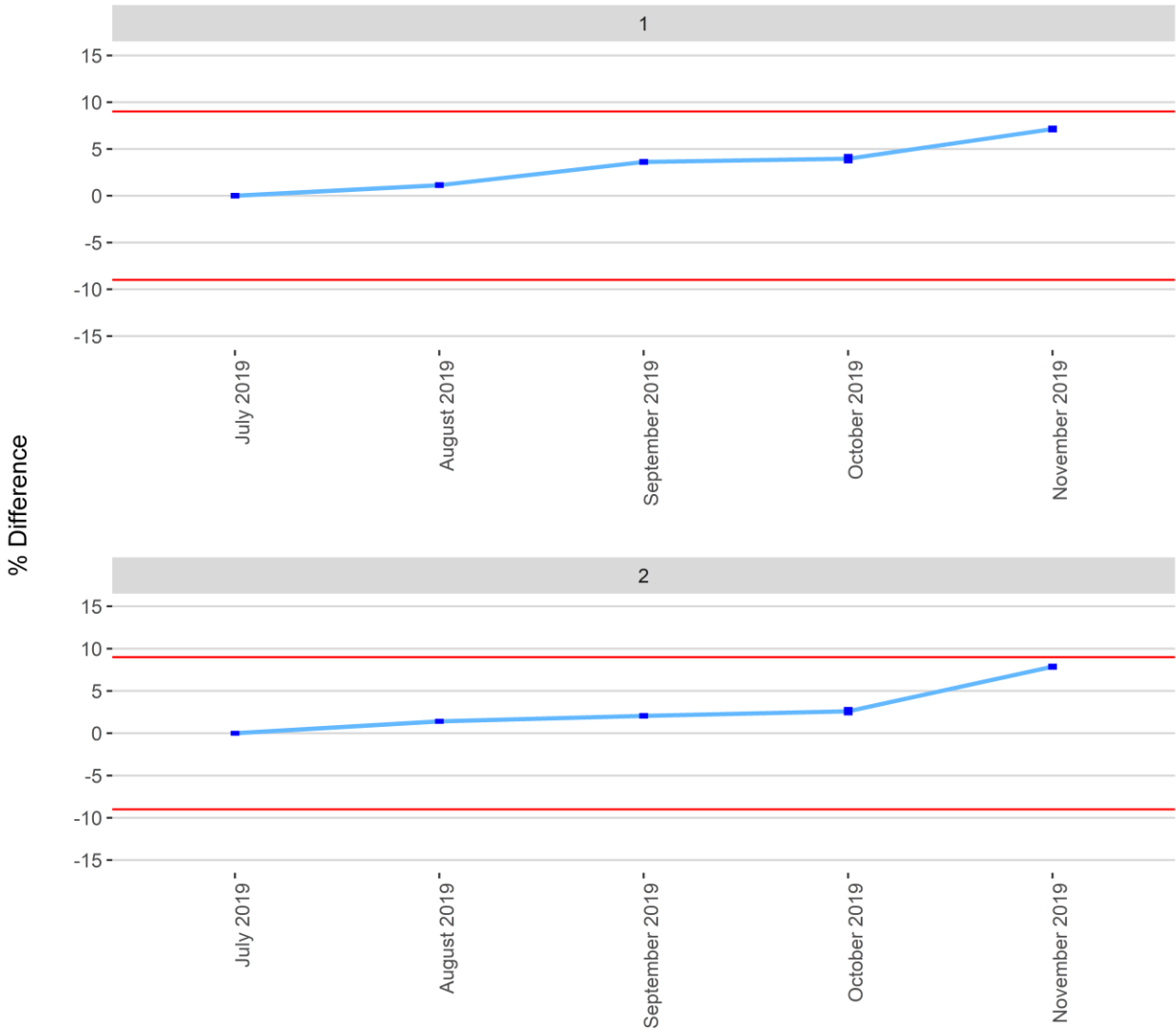


Figure 2 - Percent Difference of Front Axle Weight from
Last Calibration (+/- 95% CI)



Months that have not passed QC parameters are not displayed

Figure 2 - Average Vehicle Volume
vs. Day of the Week

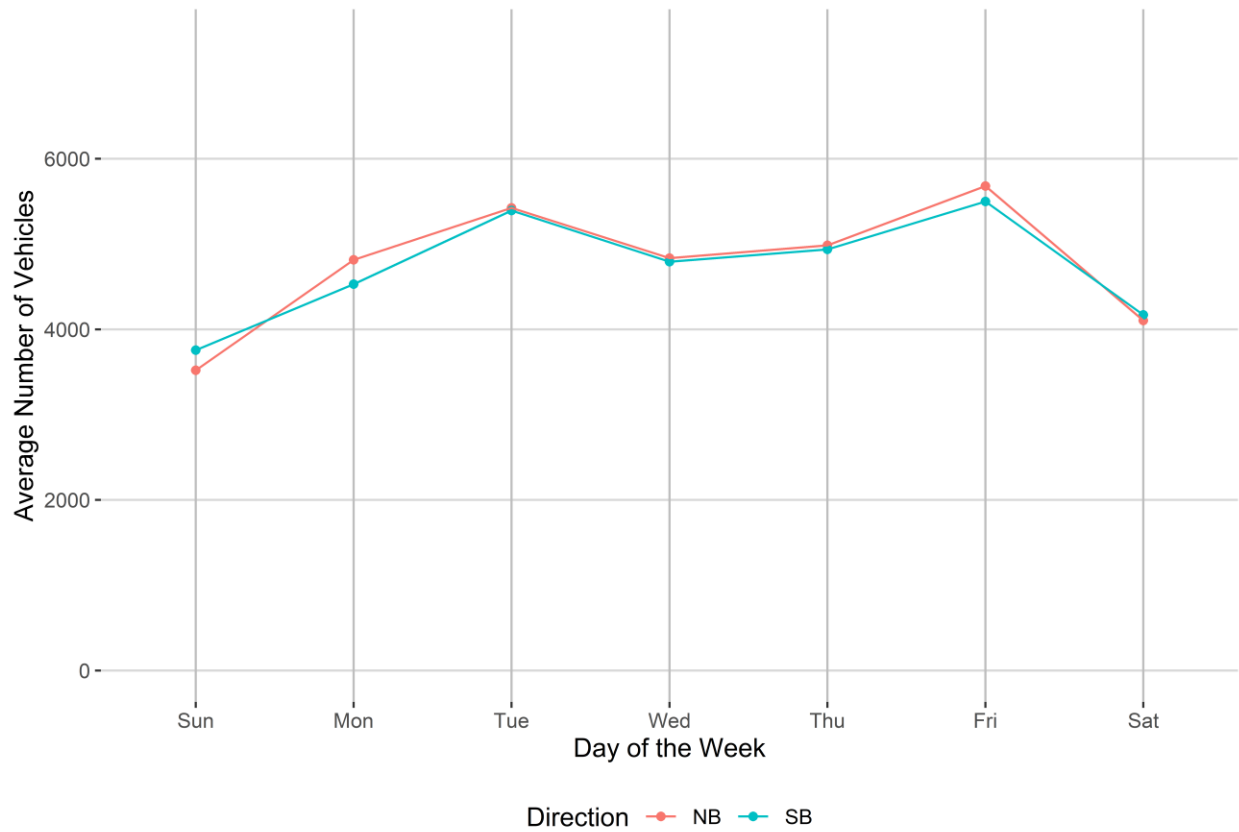


Figure 3 - Average Overweight Vehicle Volume
vs. Day of the Week

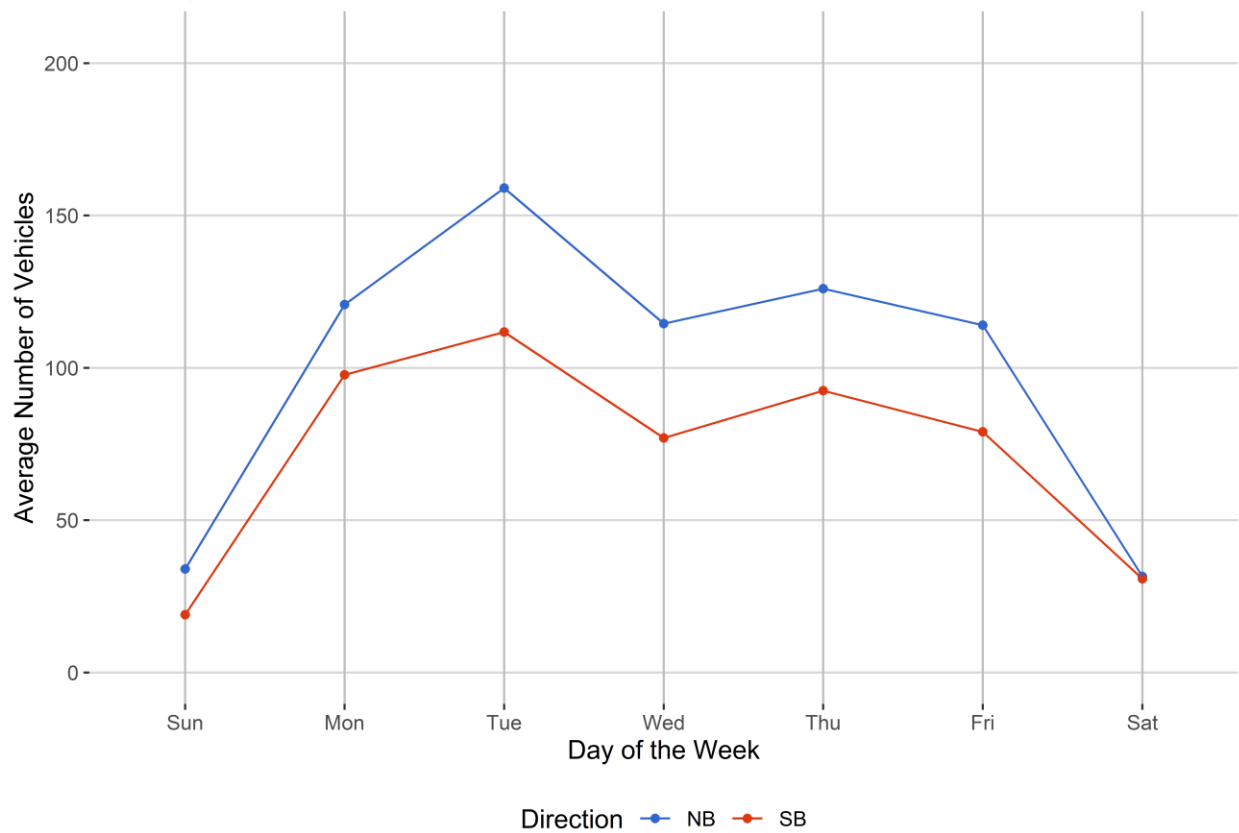


Figure 4 - Passenger Vehicles
vs. Hour of the Day

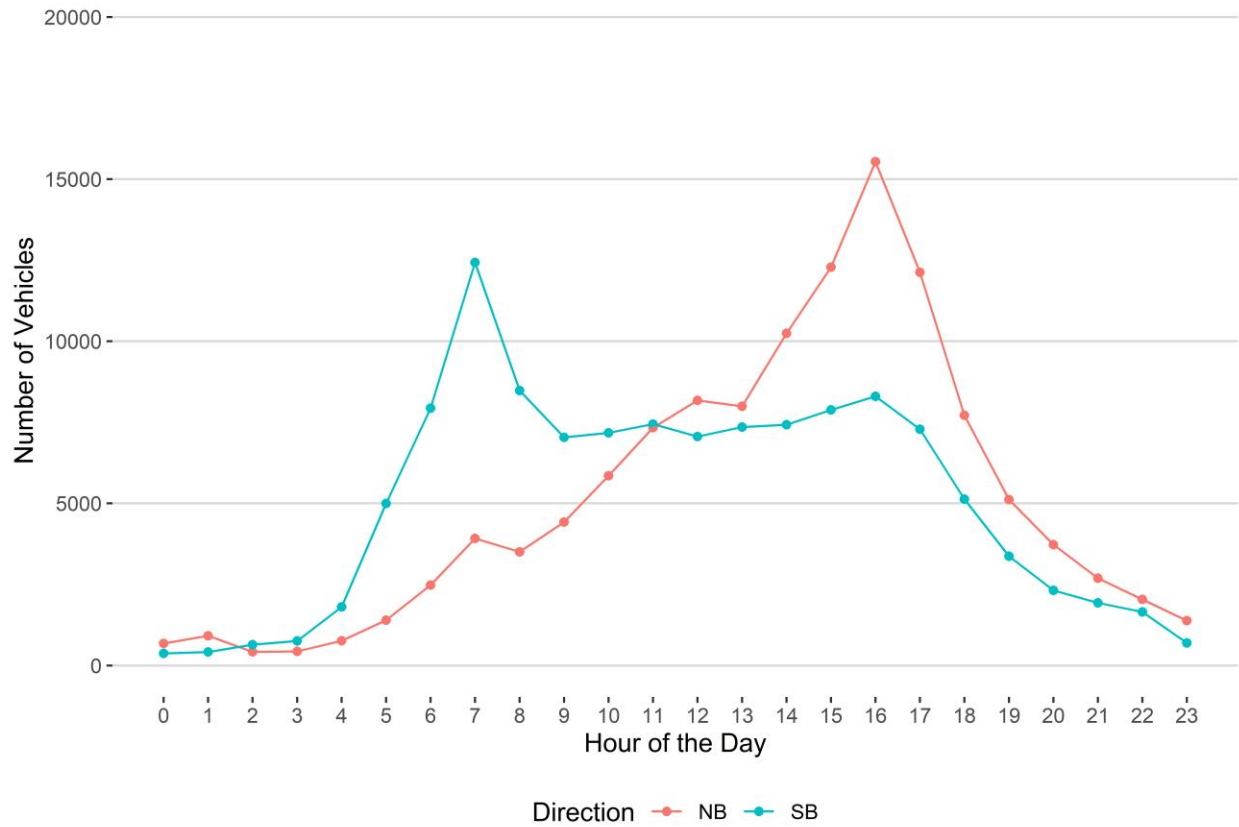


Figure 5 - Heavy Commercial Vehicles
vs. Hour of the Day

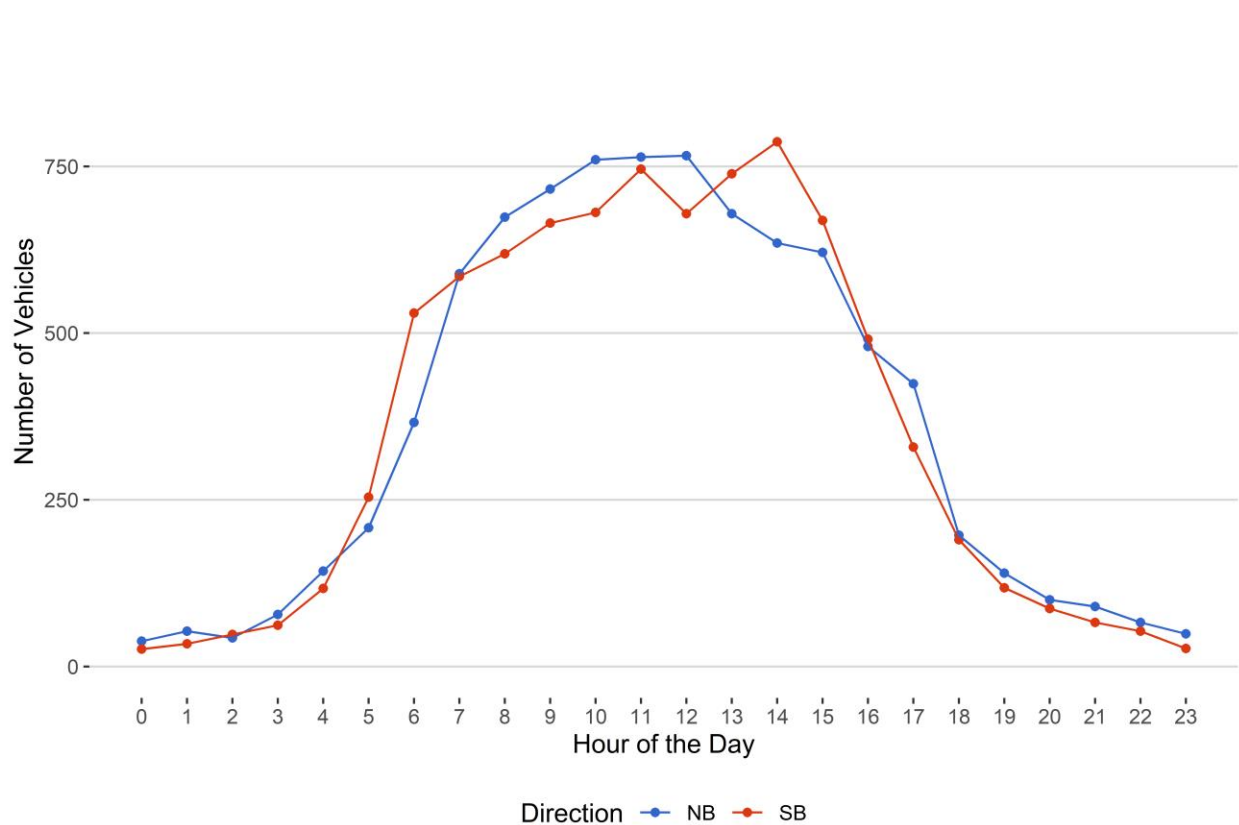


Figure 6 - Overweight Vehicles by Class
vs. Hour of the Day

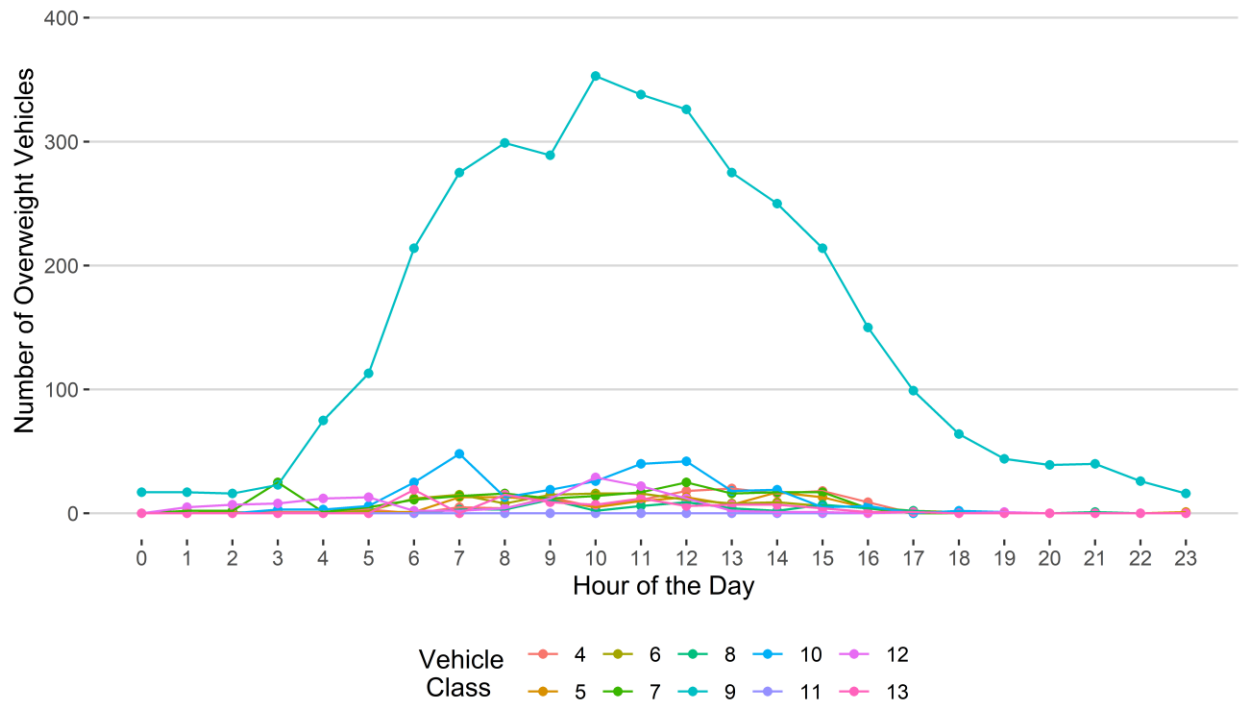


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

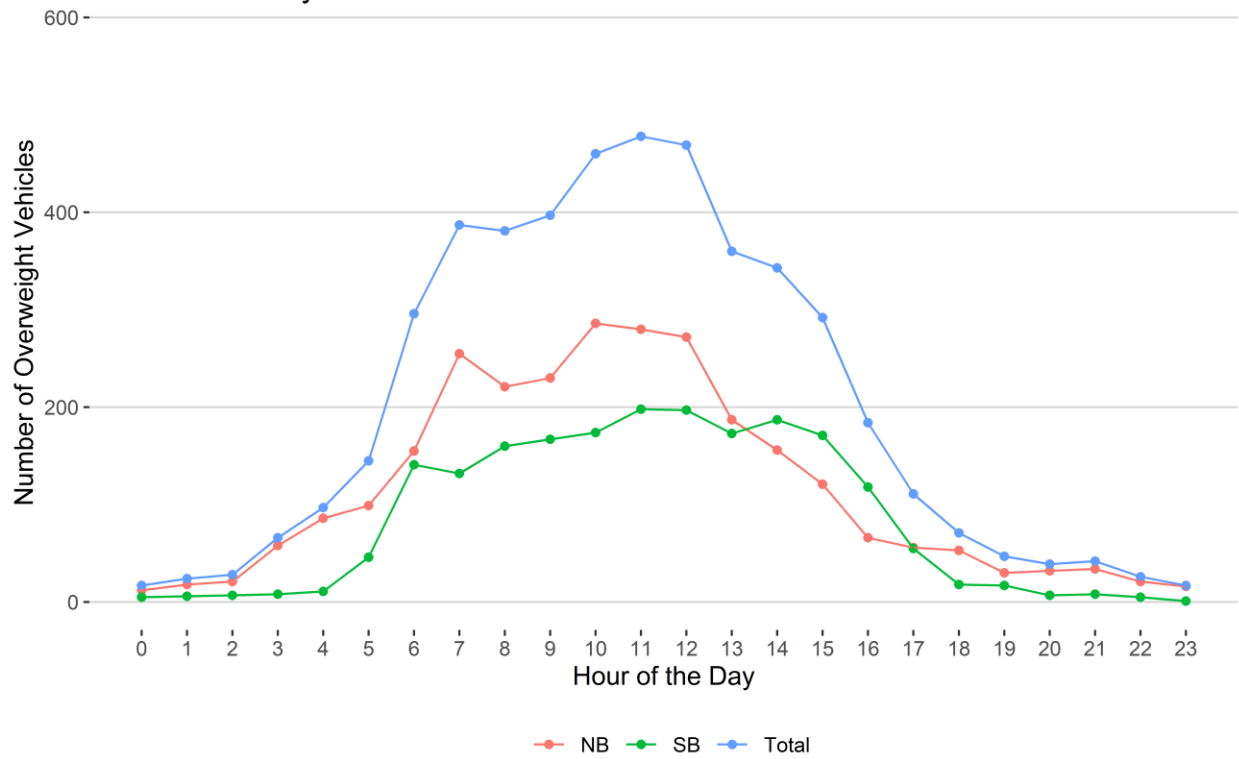
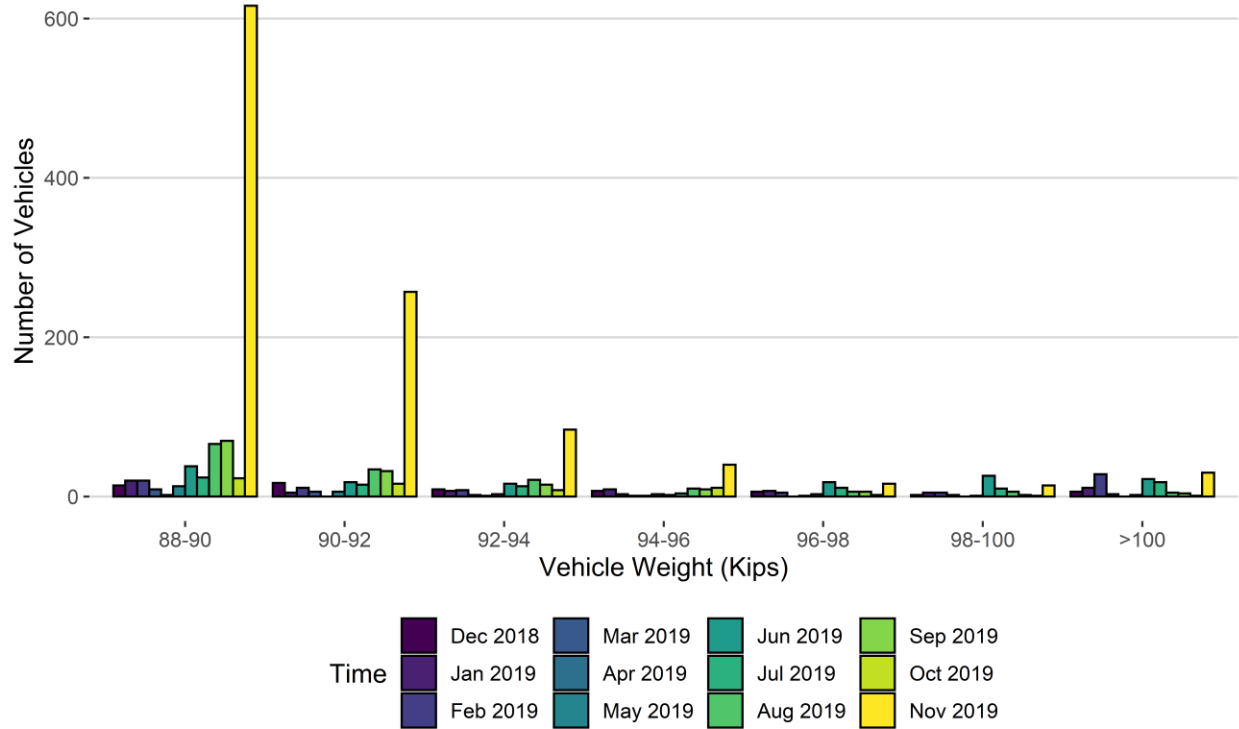
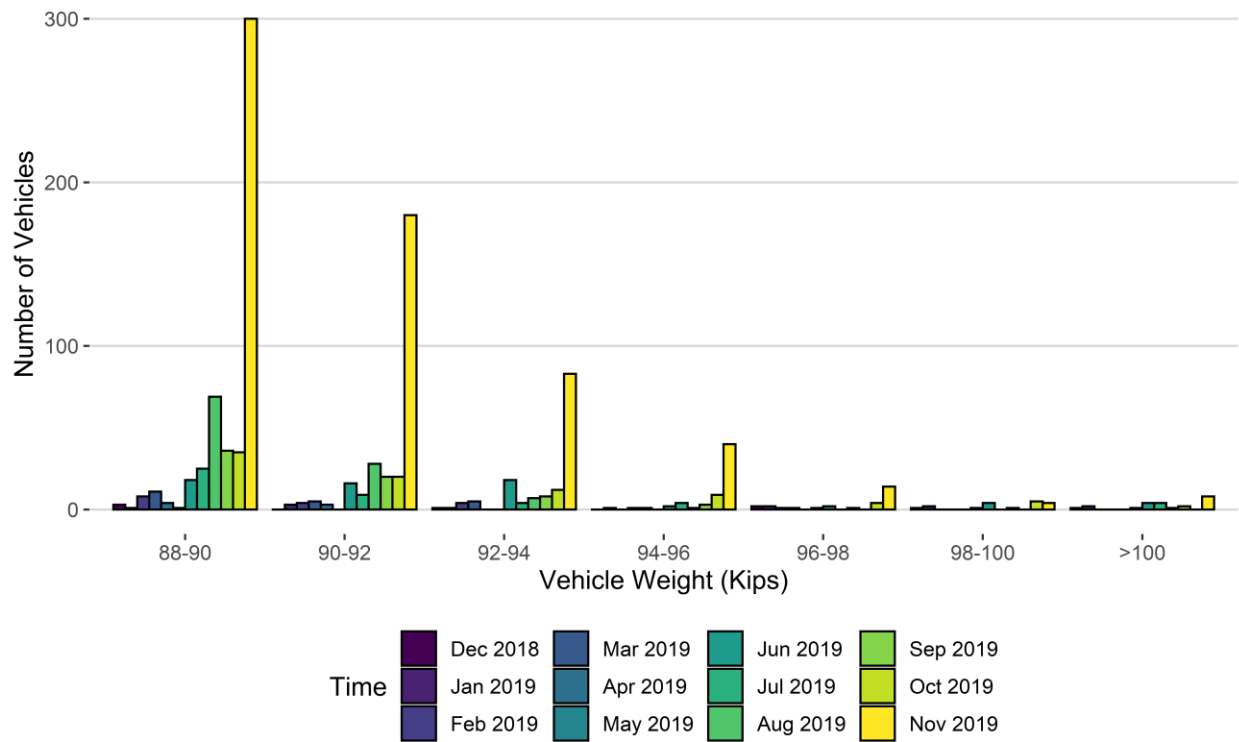


Figure 8 - Histogram of NB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Jun 2019	Jul 2019	Aug 2019	Sep 2019	Oct 2019	Nov 2019
88-90	14	20	20	9	2	13	38	24	66	70	23	616
90-92	17	5	11	6	0	6	18	15	34	32	16	257
92-94	9	7	8	2	1	3	16	13	21	15	8	84
94-96	7	9	3	1	1	3	2	4	10	9	11	40
96-98	6	7	5	0	1	3	18	11	6	6	2	16
98-100	2	5	5	2	0	1	26	10	6	2	1	14
>100	6	11	28	3	0	2	22	18	5	4	1	30
Total	61	64	80	23	5	31	140	95	148	138	62	1057

Figure 8 - Histogram of SB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Jun 2019	Jul 2019	Aug 2019	Sep 2019	Oct 2019	Nov 2019
88-90	3	1	8	11	4	1	18	25	69	36	35	300
90-92	0	3	4	5	3	0	16	9	28	20	20	180
92-94	1	1	4	5	0	0	18	4	7	8	12	83
94-96	0	1	0	1	1	0	2	4	1	3	9	40
96-98	2	2	1	1	0	1	2	0	1	0	4	14
98-100	1	2	0	0	0	1	4	0	1	0	5	4
>100	1	2	0	0	0	1	4	4	1	2	0	8
Total	8	12	17	23	8	4	64	46	108	69	85	629

Figure 8 - Class 9's and 10's by Direction
vs Gross Vehicle Weight

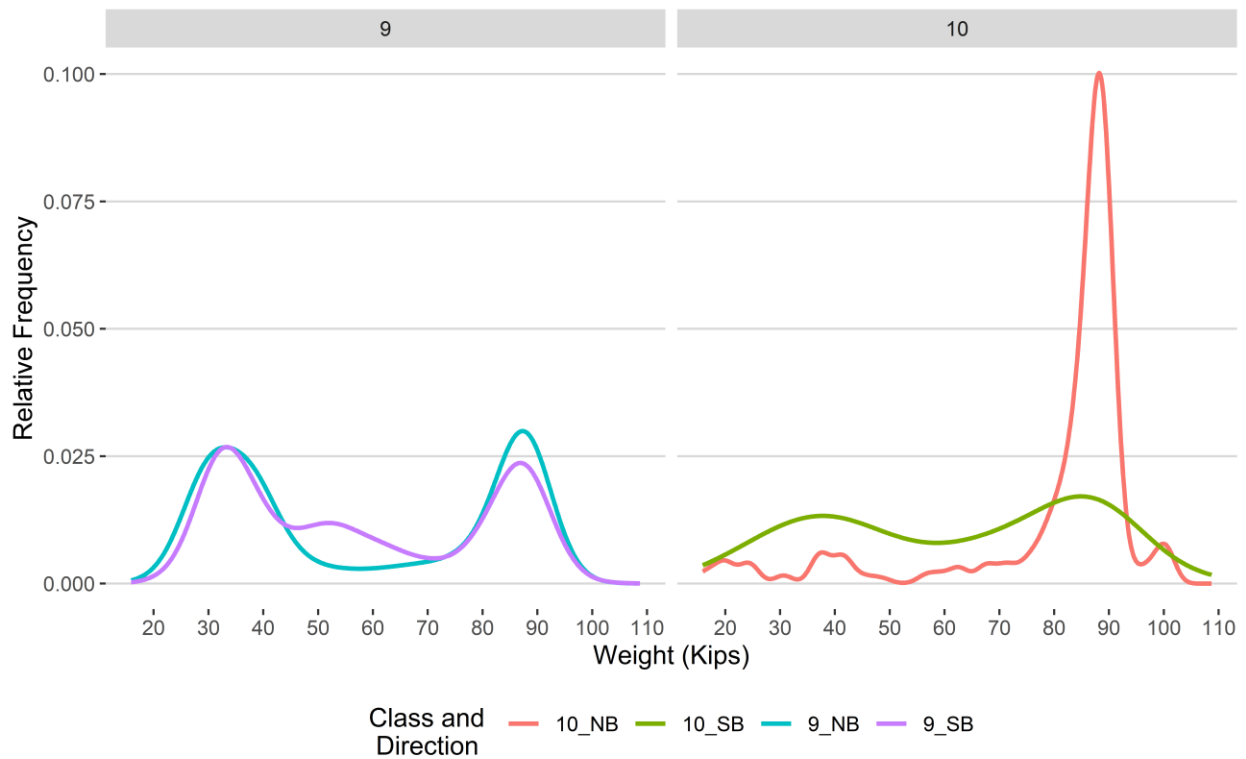


Figure 9 - Freight Percentage
by Direction and Class

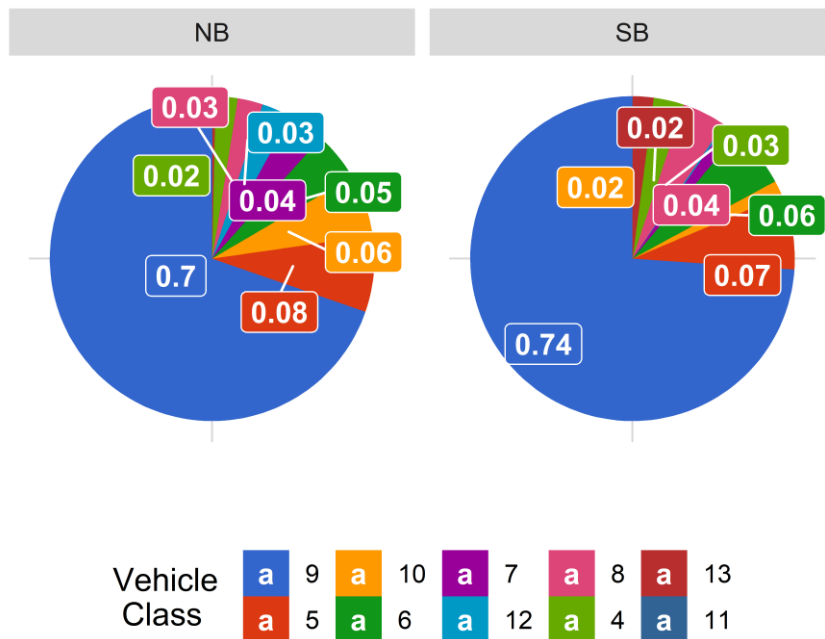


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

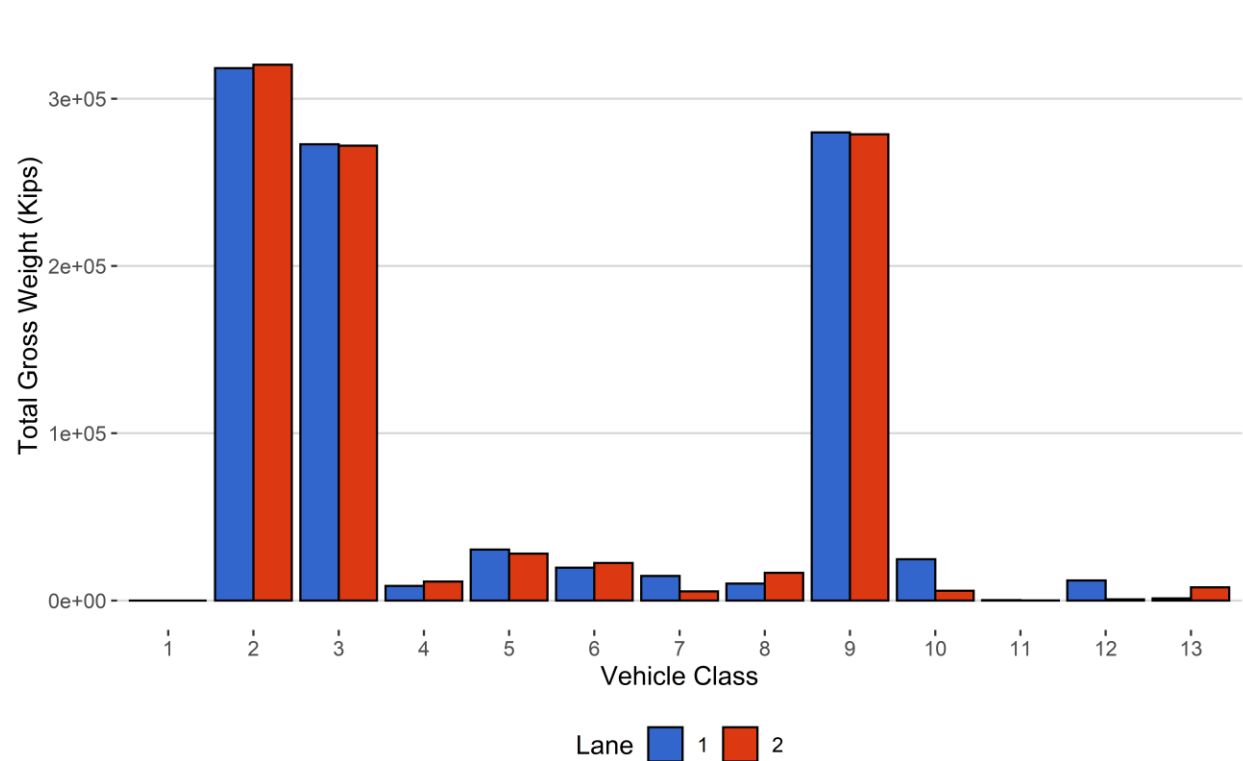


Figure 11 - Total Gross Vehicle Weight t

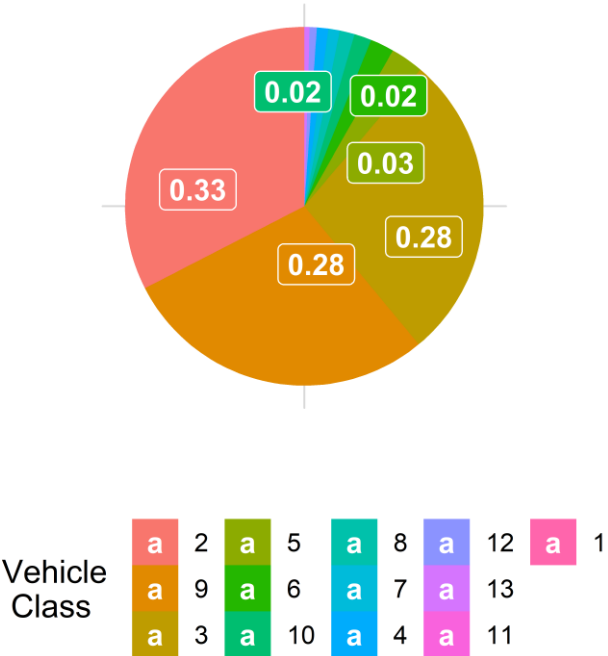


Figure 12 - Total ESALs by Class and Lane

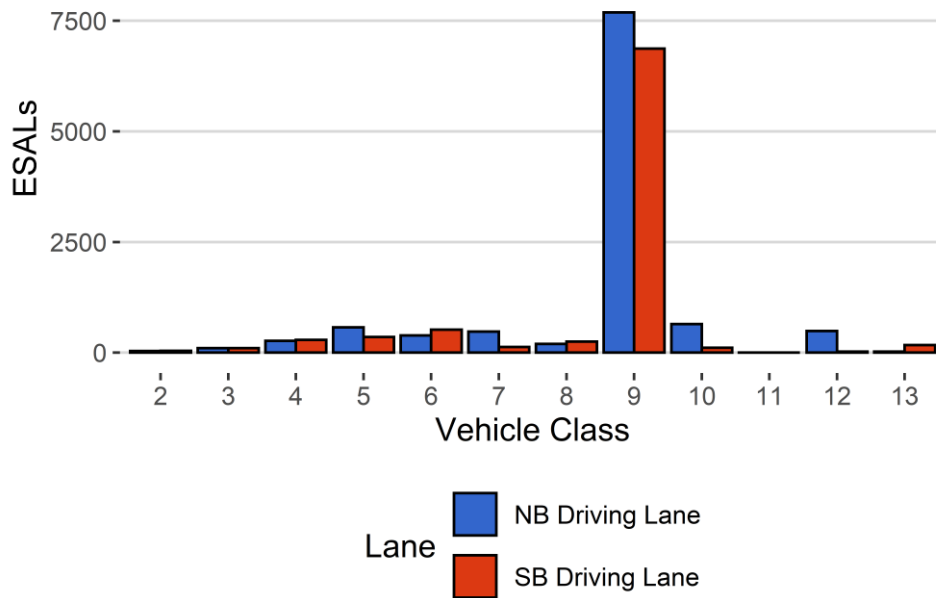


Figure 13 - ESALs by Class

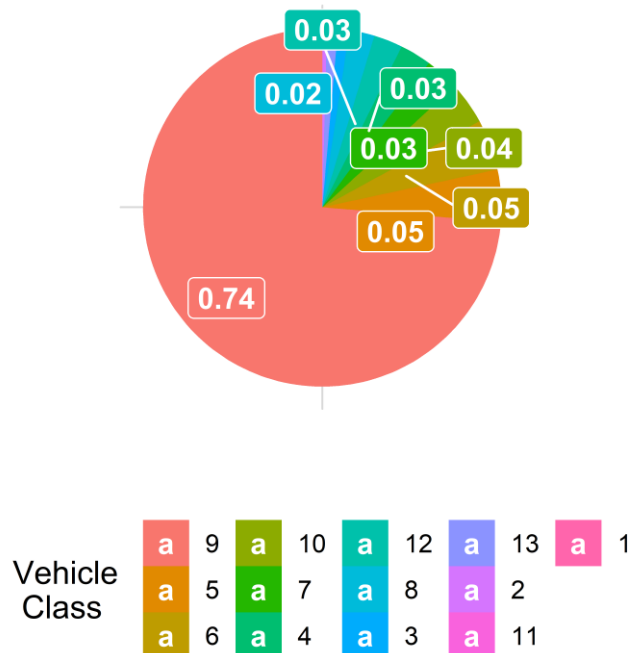


Table 1 Class 9 Front Axle Weight by Lane

<i>Month</i>	<i>Lane 1 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 2 (Kips)</i>	<i>Front Axle +/- 9%</i>
July 2019	10.82	0.00	10.95	0.00
August 2019	10.94	1.13	11.10	1.41
September 2019	11.21	3.62	11.17	2.06
October 2019	11.24	3.96	11.23	2.60
November 2019	11.59	7.13	11.81	7.87

Table 2 Vehicle Classification Data

<i>Vehicle Class</i>	<i>Monthly Average Daily Volume</i>	<i>Monthly Total Volume</i>	<i>Monthly Total Volume Percentage</i>	<i>Monthly Total Overweight Vehicles</i>	<i>Monthly Total Overweight Percentage</i>
1	0	3	0	0	0
2	5202	156069	59.8	0	0
3	2911	87330	33.5	0	0
4	19	585	0.2	125	2.7
5	137	4125	1.6	114	2.4
6	44	1326	0.5	126	2.7
7	9	268	0.1	198	4.2
8	26	783	0.3	54	1.2
9	323	9680	3.7	3572	76.2
10	14	405	0.2	276	5.9
11	0	5	0	1	0
12	5	139	0.1	134	2.9
13	4	112	0	88	1.9
TOTAL	8694	260831	100	4688	100

Table 3 Top 10 Gross Vehicle Weight, Class 9 and 10

<i>Date</i>	<i>Day of Week</i>	<i>Time</i>	<i>Vehicle Class</i>	<i>Direction</i>	<i>Lane</i>	<i>GVW (lbs)</i>
2019-11-05	Tuesday	09:07:31	10	SB	2	108.72
2019-11-13	Wednesday	03:58:06	9	NB	1	106.84
2019-11-08	Friday	12:23:30	9	SB	2	105.83
2019-11-13	Wednesday	07:02:13	9	SB	2	105.54
2019-11-29	Friday	04:07:14	9	NB	1	102.98
2019-11-19	Tuesday	12:32:09	9	NB	1	101.41
2019-11-19	Tuesday	07:15:35	9	SB	2	101.31
2019-11-10	Sunday	12:20:20	10	NB	1	101.05
2019-11-14	Thursday	12:43:48	10	NB	1	100.88
2019-11-08	Friday	12:13:04	10	NB	1	100.74

Table 4 Freight Summary

<i>Vehicle Class</i>	<i>Direction</i>	<i>Weight of Empty Vehicle (Kips)</i>	<i>Total Number of Vehicles</i>	<i>Number of Empty Vehicles</i>	<i>Percentage of Empty Vehicles</i>	<i>Total Weight of Vehicles with Freight (Kips)</i>	<i>Total Weight of Empty Vehicles (Kips)</i>	<i>Total Weight of Freight (Tons)</i>
4	NB	15	246	27	11	8416	355	2566
5	NB	8	2087	140	6.7	29401	1022	6913
6	NB	19	626	39	6.2	18928	690	3887
7	NB	11.5	187	0	0	14699	0	6274
8	NB	31	292	97	33.2	8030	2057	992
9	NB	33	4784	1094	22.9	248044	31866	63137
10	NB	33.5	309	16	5.2	24366	354	7275
11	NB	36.5	4	0	0	195	0	24
12	NB	36.5	129	0	0	11957	0	3624
13	NB	31.5	15	0	0	1228	0	378
TOTAL	****	****	8679	1413	****	365266	****	95072
<i>Vehicle Class</i>	<i>Direction</i>	<i>Weight of Empty Vehicle (Kips)</i>	<i>Total Number of Vehicles</i>	<i>Number of Empty Vehicles</i>	<i>Percentage of Empty Vehicles</i>	<i>Total Weight of Vehicles with Freight (Kips)</i>	<i>Total Weight of Empty Vehicles (Kips)</i>	<i>Total Weight of Freight (Tons)</i>
4	SB	15	334	28	8.4	10983	369	3197
5	SB	8	2003	148	7.4	26922	1075	6041
6	SB	19	689	42	6.1	21745	722	4726
7	SB	11.5	79	0	0	5485	0	2288
8	SB	31	484	172	35.5	12220	4345	1274
9	SB	33	4814	878	18.2	252301	26419	61207
10	SB	33.5	93	14	15.1	5415	378	1384
11	SB	36.5	1	0	0	61	0	12
12	SB	36.5	9	1	11.1	698	18	203
13	SB	31.5	96	0	0	7843	0	2409
TOTAL	****	****	8602	1283	****	343675	****	82742
GRAND TOTAL	****	****	17281	2696	187	708941	69671	177814

Table 5 Gross Vehicle Weight by Class and Lane

<i>Vehicle Class</i>	<i>NB</i>	<i>SB</i>	<i>Total</i>	<i>Percentage</i>
1	2	3	4	0
2	318292	320354	638645	32.6
3	272820	271931	544751	27.8
4	8771	11352	20123	1
5	30424	27997	58421	3
6	19618	22468	42085	2.1
7	14699	5485	20185	1
8	10086	16566	26652	1.4
9	279911	278721	558632	28.5
10	24720	5793	30513	1.6
11	195	61	256	0
12	11957	716	12674	0.6
13	1228	7843	9071	0.5
TOTAL	992723	969289	1962013	100
GVW/LANE	50.6	49.4	100	0.01

Table 6 ESALs by Class and Lane and Flexible ESAL Factors

<i>Vehicle Class</i>	<i>NB</i>	<i>SB</i>	<i>Total</i>	<i>Percentage</i>	<i>Flexible ESAL Factor</i>
1	0	0	0	0	0.25
2	37	39	76	0.4	0.001
3	100	103	202	1	0.0047
4	269	291	560	2.8	1.93
5	570	356	926	4.7	0.45
6	387	519	906	4.6	1.38
7	477	129	606	3.1	4.48
8	199	252	450	2.3	1.16
9	7688	6870	14558	73.7	3.04
10	647	109	755	3.8	3.7
11	4	1	5	0	1.31
12	489	24	513	2.6	6.94
13	25	171	196	1	3.27
TOTAL	10891	8863	19754	100	28
ESALS/LANE	55.1	44.9	100	-	-

Table 7 Site Summary: Volume and Vehicle Class

<i>Month</i>	<i>Total Volume</i>	<i>Monthly ADT</i>	<i>Monthly HCADT</i>	<i>Passenger Vehicles</i>	<i>Passenger Vehicles %</i>	<i>Heavy Commercial Vehicles</i>	<i>Heavy Commercial Vehicles %</i>
Dec 2018	283227	9136	453	269184	95	14042.7	5
Jan 2019	265163	8554	466	250711	94.5	14452.3	5.5
Feb 2019	230485	8232	479	217063	94.2	13422.1	5.8
Mar 2019	292495	9435	468	277981	95	14514.1	5
Apr 2019	304912	10164	510	289601	95	15311	5
May 2019	343068	10956	596	324607	94.6	18461.5	5.4
Jun 2019	324777	10826	573	307593	94.7	17184.2	5.3
Jul 2019	348634	11206	732	325932	93.5	22701.9	6.5
Aug 2019	357135	11454	713	335033	93.8	22101.6	6.2
Sep 2019	327603	11010	645	308264	94.1	19338.7	5.9
Oct 2019	NA	11311	NA	NA	NA	NA	NA
Nov 2019	260831	9710	581	243402	93.3	17428.9	6.7
TOTAL	NA	-	-	NA	-	NA	-
AVERAGE	NA	10166	NA	NA	NA	NA	NA

###ESALs

<i>Month</i>	<i>ESALS NB Driving Lane</i>	<i>ESALS SB Driving Lane</i>	<i>Total ESALS</i>	<i>Pavement Life Decrease Months</i>
Dec 2018	5907	2904	8811	0.8
Jan 2019	6958	3377	10335	1.7
Feb 2019	6867	3100	9967	2.7
Mar 2019	5986	3613	9599	1.4
Apr 2019	5142	3547	8689	0.3
May 2019	6985	3777	10762	0.4
Jun 2019	15760	9229	24989	2.2
Jul 2019	10375	8533	18908	2.3
Aug 2019	9916	9751	19667	3.7
Sep 2019	9773	7133	16906	4.9
Oct 2019	4634	3118	7753	4.9
Nov 2019	11233	9010	20243	32.3
TOTAL	99537	-	-	-
AVERAGE	8295	5591	13886	5

###Gross Vehicle Weight

<i>Month</i>	<i>GVW NB Driving Lane</i>	<i>GVW SB Driving Lane</i>	<i>Total GVW Kips</i>
Dec 18	832337	774352	1606689
Jan 19	877835	821194	1699029

Feb 19	799415	718048	1517463
Mar 19	909278	879764	1789041
Apr 19	910165	897884	1808050
May 19	1065247	1008542	2073788
Jun 19	2088761	1979618	4068379
Jul 19	1206334	1199906	2406240
Aug 19	1215957	1248274	2464231
Sep 19	1118507	1094331	2212838
Oct 19	460493	432488	892981
Nov 19	998227	971557	1969784
TOTAL	12482556	12025959	24508514
AVERAGE	1040213	1002163	2042376

Overweight Vehicles

<i>Month</i>	<i>Total Number of Overweight Vehicles</i>	<i>Overweight / Total Volume</i>	<i>Overweight / Heavy Commercial Volume</i>	<i>Number Over 88,000 lbs</i>	<i>Number Over 98,000 lbs</i>
Dec 2018	1569	0.6	12.1	69	10
Jan 2019	2033	0.8	14.1	76	20
Feb 2019	2171	1	16.1	97	33
Mar 2019	1543	0.5	10.7	46	5
Apr 2019	878	0.3	5.8	13	0
May 2019	998	0.3	5.4	35	5
Jun 2019	5488	0.9	16.2	206	56
Jul 2019	4621	1.3	20.5	142	32
Aug 2019	4984	1.4	22.7	262	14
Sep 2019	4099	1.3	21.2	213	8
Oct 2019	1929	1.6	23.1	151	8
Nov 2019	4777	1.8	27.5	1703	61
TOTAL	35090	-	-	3013	252
AVERAGE	2924.2	1	16.3	251.1	21

Freight

<i>Month</i>	<i>NB Freight Tons</i>	<i>SB Freight Tons</i>	<i>Total Freight</i>	<i>NB Freight %</i>	<i>SB Freight %</i>
Dec 2018	64666	33961	98626	65.6	34.4
Jan 2019	74186	39952	114137	65	35
Feb 2019	75948	36919	112867	67.3	32.7
Mar 2019	66257	43378	109635	60.4	39.6
Apr 2019	61073	46223	107296	56.9	43.1
May 2019	82977	48135	131113	63.3	36.7
Jun 2019	158224	107695	265919	59.5	40.5

Jul 2019	105124	92680	197804	53.1	46.9
Aug 2019	95517	101710	197227	48.4	51.6
Sep 2019	93197	75504	168701	55.2	44.8
Oct 2019	43214	31801	75015	57.6	42.4
Nov 2019	95072	82742	177814	53.5	46.5
TOTAL	1015455	740699	1756154	-	-
AVERAGE	84621.2	61724.9	146346.2	58.8	41.2